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Research Briefs

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Inside

- Vitalamins: The new nutrients.—p. 3
- Two cocktails a day raised estrogen levels in women, linking these two suspected risks for breast cancer.—p. 2
- Tomatoes may not grow, look or taste like potatoes, but they're kissin' cousins.—p. 2
- This new "Georgia peach" is a winner across the South.—p. 3
- Two new advances against salmonella in chickens.—p. 4
- Some folk remedies for diabetics are gaining new respect in lab tests.—p. 2

Nutrition and Health

Taxol, approved last year by the Food and Drug Administration as a drug for ovarian cancer, could be produced from Maine's yew bushes. A database developed by ARS scientists revealed that needles of the bush, *Taxus canadensis*, from Maine contain five times more taxol than found in the bark of the western yew trees, *T. brevifolia*. Currently, western yews must be destroyed for their bark to extract this chemical, whereas the Maine bushes produce new needles each year. Taxol is also showing promise for the treatment of other types of cancer that cause the death of nearly 300,000 Americans yearly. As a by-product of the extraction process, energy alcohol could be produced along with several other useful chemicals.

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Regular aerobic exercise can lower people's risk of diabetes, even if they don't lose weight in the process. That's the finding of a three-month study of 18 older men and women who had above-normal glucose levels on a glucose tolerance test. This puts them at a nine- to 10-fold greater risk of diabetes. But the 18 volunteers cleared 11 percent more glucose from their blood after cycling on an ergometer four days per week. After 12 weeks, the exercise improved the ability of their cells to respond to insulin,

allowing them to process the glucose more efficiently. The finding supports other research showing that exercise itself improves people's insulin sensitivity. That's good news because weight loss—widely prescribed as a treatment for diabetics—is often not permanent.

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Test animals cope with a copper-deficient diet far better when given only 60 to 70 percent of the calories they would normally eat. Results of two recent rat studies suggest a possible relationship between the effects of copper deficiency and aging because copper-deficient diets are known to produce several symptoms common to aging—including anemia and damage to the heart muscle. And in numerous animal studies by other investigators over several decades, restricting food intake throughout life has dramatically delayed the onset of age-related diseases and nearly doubled the animals' life span. Such studies, obviously, cannot be done on people, however. In the latest studies, rats fed the restricted diet had significantly less anemia and heart enlargement from the copper-deficient diets than those who got all the food they could eat. They also lived substantially longer: All survived until day 42 compared with 40 percent of the well-fed group. What's more, a copper-containing enzyme—SOD—was more active in the food-restricted group, indicating the group had better protection against oxygen free radicals.

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People can't substantially raise vitamin E levels in their blood by diet alone. It takes a daily vitamin E supplement of at least 100 International Units (I.U.), according to a new study. In light of recent evidence suggesting that taking vitamin E supplements protects both men and women against coronary artery disease and reduces risk of certain cancers, researchers with the National Cancer Institute and ARS looked at the relationship between vitamin E intake and plasma levels in 65 men. Vitamin E intake from the diet did not differ significantly among the men. Their diets provided less than 15 I.U. per day. But they fell into three groups based on their use of vitamin supplements: those who did not take supplements on any regular basis; those who got an extra 15 to 60 I.U. daily from multivitamin supplements; and those who got an extra 100 I.U. or more

from a vitamin E capsule. Plasma vitamin E levels were somewhat higher (14 percent) in the group that took multivitamin supplements compared to the group that did not take any supplements. But they were more than twice as high in the group that took vitamin E capsules on a daily basis. It is virtually impossible to get 100 I.U. of vitamin E from diet alone. The normal adult intake is 10 to 15 I.U. And because it is a fat-soluble vitamin, the richest sources are vegetable oils and the high-fat products made from them. Unfortunately, science has not yet determined what levels of plasma vitamin E are necessary to protect against heart disease or cancer.

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Two suspected risk factors in breast cancer—moderate alcohol consumption and exposure to estrogen hormones—have now been linked. A six-month study at ARS' Beltsville Human Nutrition Research Center was one of the first long-term, controlled-diet experiments of its kind. The equivalent of two mixed drinks a day increased estrogen levels seven to 32 percent during the menstrual cycle of 34 healthy women volunteers 21 to 40 years old. The results suggest moderate alcohol consumption may be one mechanism responsible for elevated estrogen—long implicated in breast cancer. Results may also explain why some earlier studies implicated moderate drinking as a risk factor. ARS jointly conducted the study with the National Cancer Institute. The scientists measured estrogen hormones in blood and urine samples about a week before, during, and a week after ovulation. The greatest increase in hormones was in the week of ovulation.

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Some folk remedies for diabetes appear to be based on fact rather than fiction. That's what ARS researchers are finding in studies to identify foods that may help control diabetes in lieu of drugs. They used a well-known test-tube assay of insulin activity to screen extracts of 24 plants that have a reputation for antidiabetic properties. The assay measures the ability of a substance to enhance glucose oxidation in the presence of insulin. Nine of the 24 plants boosted insulin activity from two- to 4.5-fold. The common weed, loosestrife (*Lythrum salicaria*), produced the biggest increase. Others were bearberry (*Arctostaphylos uva-ursi*); hops (*Humulus lupulus*); lavender (*Lavandula stoechas*); oregano (*Origanum vulgare*); sage (*Salvia officinalis*); dandelion (*Taraxacum officinale*); sweet bay (*Laurus nobilis*); and birch (*Betula lenta*). These substances are generally prepared as teas or tinctures. Sage and oregano are common herbs used in cooking. Hops and lavender are food additives generally recognized as safe. Earlier assays

found several spices, such as cinnamon and tumeric, to be effective. The researchers hope ultimately to test the most effective compounds in human studies.

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Cholesterol's bad reputation apparently doesn't hold up for infants. A study of four-month-old infants indicates that they need more cholesterol than commercial formulas provide. The group getting formula containing one-sixth the cholesterol in breast milk made their own cholesterol three times faster than the breast-fed infants. Even with the faster synthesis, the formula-fed group had 39 percent less cholesterol circulating in their blood than the breast-fed infants. And LDL-cholesterol—which has the bad reputation—was nearly twice as high in the breast-fed babies. The findings again raise the question whether cholesterol should be added to infant formula. Cow-milk-based formulas contain less than 25 percent of the cholesterol in mother's milk, and soy-based formulas contain less than seven percent. Some animal studies have led scientists to speculate that the high-cholesterol intake infants get from mother's milk may help protect them later in life from diet-induced increases in plasma cholesterol. But studies with other animals did not show this long-term benefit. Further research comparing former breast-fed and formula-fed infants is needed before any solid recommendations can be made. This study was the first of its kind done on human infants.

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Tomorrow's Foods

Tomatoes and potatoes, two of the world's most popular vegetables, come from plants that are so closely related they should be in the same genus. That was the finding of ARS and university researchers who studied genetic material in both vegetables. Potatoes are now in the *Solanum* genus—and so were tomatoes in the mid-18th century. But later, an English botanist moved them to the *Lycopersicon* genus—and scientists have debated the issue since. Now researchers say tomatoes should be moved back to *Solanum*, based on an examination of genetic material from the chlorophyll-containing bodies of 21 *Solanum* species, three *Lycopersicon* species, and three other related genera. They compared the genetic material among the various species—allowing them to establish that potatoes and tomatoes are "sister" plants. They also based their finding on morphological traits such as the flowers and overall plant form.

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"Vitalimins" — The New Nutrients

Around 30 years ago, some futurists were predicting that we would be taking our meals in the form of giant pills chock full of all the essential nutrients in concentrated form. They neglected to consider that it takes about one pound of food per day to replace the calories we burn. Even for vitamins and minerals, the idea was science fiction then, and it remains so today.

The more we study the relationships between eating habits and human health, the clearer it becomes that we are far from knowing all of the physiologically active components of food. In the last decade, research has uncovered many candidate nutrients in vegetables, fruits, grains and even milk that seem to maintain health at levels found in a typical diet. I call these compounds "vitalimins"—meaning factors for life nourishment.

The foods we eat, for example, contain some 50 carotenoids. But the human body converts only four or five of them into vitamin A. The rest may serve as antioxidants—keeping oxygen radicals from damaging critical molecules including DNA—or as detoxifiers—helping the body dispose of carcinogens before they can do damage.

Several other classes of compounds in plant foods, including flavonoids, indoles and phenols, may protect against coronary artery disease and cancer at levels nor-

mally found in the diet. Other food components that promote health at higher levels than found in the diet may lead to new ideas for pharmaceuticals.

While research has focused on vegetables and fruits because of their strong association with lower rates of heart disease and cancer, we can't discount milk, eggs, meat, fish and other seafood as sources of vitalimins.

Nature has supplied a broad range of compounds that our bodies can use, possibly interchangeably, to promote health. And low intakes seem to increase risk of diseases of aging. Before the compounds can be deemed essential, however, nutrition science needs more sophisticated techniques to learn how they function in the human body. One powerful new tool is the use of foods grown to be highly enriched in non-radioactive isotopes of basic elements—carbon, hydrogen, oxygen and nitrogen.

That's why it is important to get nutrition from foods rather than supplements and to eat a wide variety of foods, tastily prepared with herbs and spices. And by adding more vegetables, fruits and cereals to the diet, people will tend to eat fewer high-fat, high-sugar foods. It's much easier to accentuate the positive than it is to eliminate the negative.

*Jacqueline Dupont, National Program Leader
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A new eating peach bred and released by ARS scientists resists bacterial spot, a common disease of peaches. The new peach—*Flameprince*—matures in August and measures two-and-a-half to three inches in diameter, with a golden yellow background color that makes it easy to judge ripeness for picking. The bright red, freestone fruit is very firm, with excellent quality and texture. *Flameprince* has been field tested in Alabama and Texas, has produced good crops in Georgia for 10 years and is suggested for trial in the middle chilling zones of the southeastern United States. The peaches don't drop prematurely as late peaches can, but soften slowly on the tree. Trees will be available from nurseries in winter, 1993-1994.

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A gene from citrus has been isolated for the first time—an important step toward being able to select and insert into citrus the specific genes that control desirable traits such as cold hardiness. Cold hardiness and other stress-related traits in citrus are not well understood and are therefore difficult to genetically engineer. But ARS scientists isolated a gene from trifoliate orange, a cold-hardy citrus that bears bitter inedible fruit but serves as a good rootstock for sweet orange. The technology to regenerate a complete citrus tree

from one cell is available, but that produces a replica, not a genetically different plant. ARS scientists are using electrical shock to create tiny holes in citrus cell membranes through which they can insert new genetic material—i.e., DNA. The holes reseal and the cells function normally with the foreign DNA inside. Specialized cell lines for all the major types of sweet orange grown in Florida have been developed and are being routinely used in research. Other expected genetic targets are genes that improve juice color and increase plant proteins that defend against disease and insect attack.

*U.S. Horticultural Research Laboratory, Orlando, FL
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Newly designed protein products for foods, feeds and industrial uses could be made from soybeans. ARS researchers developed a method to assess what happens to soy proteins and other components during heat processing. Industry now uses high temperatures and low moisture conditions for processes such as roasting, frying and extrusion cooking. The model system demonstrates to soy processors what specific changes occur in soy proteins when cooked at lower temperatures and under different moisture conditions. Once it is known exactly how much heat is needed then proteins can be designed with specific

functions. The benefit to industry is that it's possible to cut time and energy costs by turning down the heat.

*National Center for Agricultural Utilization Research
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Food Freshness and Safety

A method for excluding salmonella, a major food-poisoning bacterium, from the intestines of hatching chicks has been patented by ARS scientists. Researchers placed harmless chicken-intestinal bacteria, previously grown in laboratory cultures, into developing eggs three days before hatching. The purpose was to colonize the hatching chick's intestines, which do not contain bacteria, with harmless bacteria so that there wouldn't be enough room for the salmonella bacteria to gain a toehold. Birds that hatched from treated and untreated eggs were fed with salmonella bacteria. The treated birds were resistant to the salmonella: Even when given 10 million of the bacteria, only half became infected, while all the untreated birds became infected. Embrex Inc., Research Triangle Park, NC, has been granted a license by ARS to commercially develop the competitive exclusion technique for salmonella.

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ARS has granted a patent to Difco Inc., of Detroit, MI, to manufacture an improved pre-enrichment medium for the detection of salmonella—a major cause of food poisoning. The new medium offers a seven percent improvement in salmonella detection over currently used pre-enrichment media. That means cooked meat products are less likely to contain salmonella upon leaving the factory. Federal law requires that ready-to-eat meat products such as hot dogs and cold cuts have no salmonella bacteria when they leave the processing plant. A pre-enrichment medium is used to "rehabilitate" bacteria injured but not killed by heating or other bacteriocidal treatments. This medium allows very small quantities of the bacteria, undetectable by routine culture methods, to multiply to sufficient numbers to be detected by standard tests for their presence. The new medium can also be used to help detect salmonella on food processing equipment and in raw meat. Before being placed on the market, it will undergo rigorous testing by 10 independent laboratories.

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Pharaoh ants are usually considered indoor pests, but putting toxic baits outdoors is an effective way to control them. These pests infest hospitals, food establishments, offices, apartments and other buildings. Although they live inside, they often forage outside for food that they can bring

back to their nests. To control the pests, scientists placed commercial bait stations containing a delayed-action insecticide along the exterior walls of apartment buildings. The researchers found that within one week, Pharaoh ant populations were reduced by 90 percent. Outdoor control with bait stations may result in lower control costs and will mean less exposure to insecticides indoors.

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Compounds found in everyday foods could inhibit the growth of bacteria linked to food-borne illnesses. In lab tests, a naturally occurring preservative called nisin suppressed the growth of *E. coli* 0157:H7 and *Salmonella typhimurium* when combined with common food additives. Among the additives are EDTA, sodium hexametaphosphate, citric acid or lactic acid. In the tests, 70 million each of *E. coli* and salmonella bacteria were treated with the mixtures for either 60 minutes at 99 degrees F, or 30 minutes at 41 degrees F. After either treatment, only 100 to 10,000 *S. typhimurium* and 50 to 1,000 *E. coli* cells remained. ARS scientists are developing the proper mixture of nisin and other compounds to reduce these and other bacteria that can contaminate red meat.

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Catfish processors can more effectively detect compounds that cause rancidity in frozen fillets by testing only the dark meat instead of the whole fillet. Oxygen, seeping into fillets during storage, breaks down fat to make compounds called aldehydes. But ARS and Mississippi State University scientists found more aldehydes in dark meat, which contains more fat and also more iron and copper—which act as catalysts for fat breakdown—than white meat. Chemical analyses for aldehydes done on dark meat accounted for over 90 percent of rancid flavors that a taste panel detected in whole fillets. When these tests are done on the whole fillet, which is about 90 percent light meat, the results don't correlate well with scores given by the taste panels on which most processors rely. Now, processors can use aldehyde analyses for evaluating how well antioxidants, new packaging techniques or handling practices delay rancidity and therefore prolong shelf life. *ARS Aquaculture Research Project, Tishomingo, OK
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